

P530/2
BIOLOGY
(Theory)
JUNE-2025
2 Hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION
CONTINUOUS ASSESSMENTS-TERM II
SENIOR FIVE
BIOLOGY
(Theory)
Paper 2
TIME: 2 HOURS

INSTRUCTIONS TO ITEM TAKERS

- Respond to item **one** in Section **A** plus any **two** items in Section **B**.
- You are advised to read each item carefully, prepare their responses, present them precisely and logically illustrating with well labeled diagrams where necessary.
- Start the responses of each item on a fresh page.
- Use a pencil for drawings only.

SECTION A
(The Item in this section is compulsory)

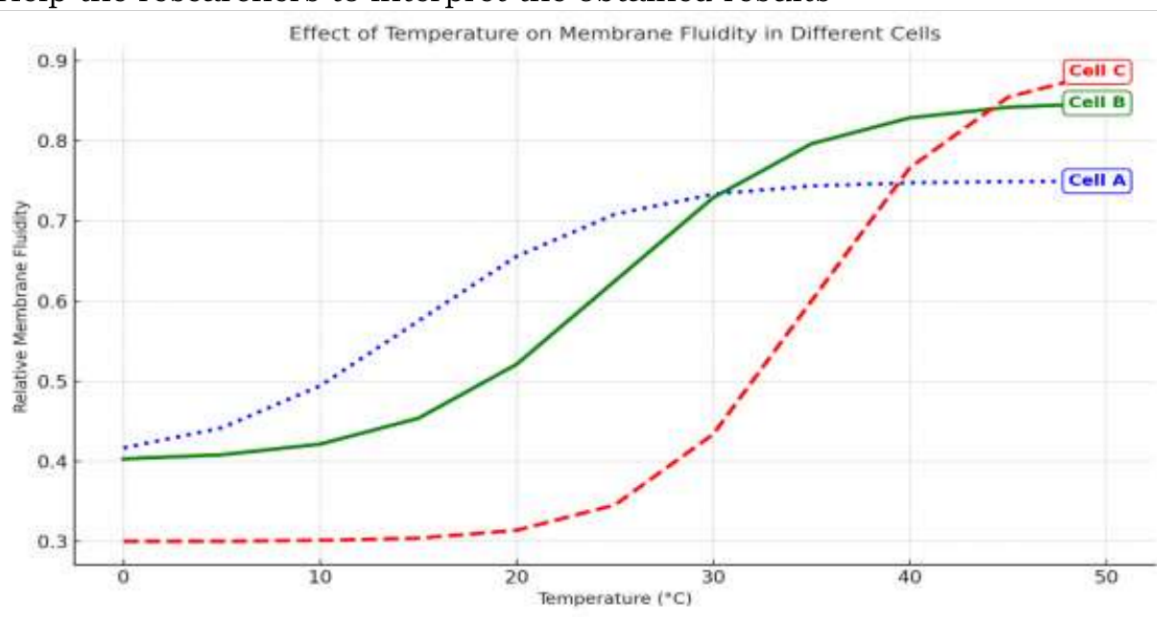
ITEM 1

A team of researchers wanted to investigate how the difference in cell membrane compositions of organism could influence the fluidity and functioning of the plasma membranes. They obtained cells from three different animals living in different climatic conditions.

- **Cell A:** Arctic fish cells
- **Cell B:** Human skin cells
- **Cell C:** Desert lizard cells

Each cell type was subjected to the increasing temperatures from **0°C to 50°C**, and the relative membrane fluidity was measured. The results are shown in the graph below.

Help the researchers to interpret the obtained results



TASK:

- (a) State and explain the observed differences in the trends of the membrane fluidity between cell **A** and **C** across the temperature range. **(08 scores)**
- (b) Why would a rapid drop in the environmental temperature be more dangerous to organisms with a cell type **C** than those with cell type **A**? **(03 scores)**
- (c) Relate how the changes in the structure's fluidity can be of great importance in the lives of organisms with such cell types. **(06 scores)**
- (d) Explain how the components present in all the observed cell types are responsible for maintaining fluidity at low and high temperatures. **(05 scores)**

- (e) Suggest how a decrease in the structure's fluidity could affect its transport and enzymatic roles? **(04 scores)**
- (f) Predict what would happen to the membrane fluidity if;
- (i) An organic solvent like ethanol was added to all the cells. **(02 scores)**
 - (ii) Lipids in the cell **C** membrane were replaced with those from cell **A** at high temperatures? **(02 scores)**

SECTION B

(Attempt only two items from this section)

ITEM 2

A group of S.5 students during a lesson of cytology wanted to understand how the different parts of an animal cell contribute to its overall function. The learners' observed carefully micrographs of a liver tissue that was taken from a healthy resting mammal and noted the following features in the cells.

- **Structure A:** Prominent nuclei
- **Structure B:** Extensive Golgi apparatus
- **Structure C:** Many mitochondria
- **Structure D:** Lysosomes
- **Structure E:** Many glycogen stores.

However, they were challenged on how they would relate these structures to their functions and so consulted your help.

TASK:

- (a) State one function for each of the observed cell organelles. **(05 scores)**
- (b) Describe the structure of the membrane bound organelle that were would be affected by a respiratory poison? **(05 scores)**
- (c) Some of the observed cells had multiple numbers of structure **A**, of what biological significance would this offer to such a cell? **(02 scores)**
- (d) How would the abundance and presence of each of the observed organelles differ between a resting mammal and a fast running mammal? Explain? **(08 scores)**

ITEM 3

A group of S.5 students who were interested in investigating how protein structure determines their biological function in living organisms decided to visit a biomedical research centre. The instructor of the research centre obtained four protein samples from a mammal, each of which played a vital role in the mammal's body. The instructor told them that these proteins not only differ in their structural organization but also in their physical forms- some are **fibrous** while others are **globular**. The samples were;

- **Sample A:** Myoglobin
- **Sample B:** Keratin
- **Sample C:** Haemoglobin

- **Sample D:** Insulin hormone

Help the students to understand how the structure of the observed proteins can be are directly related to their biological roles.

TASK:

- Classify each of the four proteins in terms of their levels of structural organization and also state whether it is fibrous or globular. **(04 scores)**
- Mention the biological roles of each of the protein in the four samples. **(04 scores)**
- State the structural differences between the two forms of proteins and then relate how the structure of such proteins relates to their function. **(07 scores)**
- If a genetic mutation replaces one of the amino acids in the protein from sample **C**, Explain how this would affect the protein structure and shape as well as the overall biological function of the cell where such proteins occur? **(05 scores)**

ITEM 4

A team of scientists in a biotechnology company were developing enzyme based solutions for some commercial uses. During the development of the enzyme solutions, they observed that the developed enzyme molecules catalyzed their reactions efficiently at 37°C and under neutral pH. They further noticed that the enzyme's activity could also be affected by the presence substance **T** which had a shape similar to that of the normal substrate enzyme molecules acted upon. During the discussion at lunch, one researcher mentioned that the enzyme's action might follow either the look and key model or the induced fit hypothesis, which left the human resource manager who was seated with them to be confused.

TASK:

- Explain how the **extreme** of the conditions that were observed during the investigations could affect the functioning of such biological molecules. **(09 scores)**
- Differentiate between the two models the researcher stated as being the mode of action of such biological molecules. **(04 scores)**
- In what ways do such investigated biological molecules differ from inorganic catalysts? **(04 scores)**
- Give areas where molecules of similar nature to **T** could be of great use? **(03 scores)**

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